

REVIEW OF AFROTROPICAL BEACH FLIES OF
THE TRIBE CANACINI AND SUBFAMILY NOCTICANACINAE
(DIPTERA: CANACIDAE)

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Abstract.—Afrotropical beach flies of the tribe Canacini and subfamily Nocticanacinae are reviewed. Included are 3 species in *Canace* Haliday, 6 in *Nocticanace* Malloch, and 5 species in *Procanace* Hendel. Four new species are described: *Canace zyuv* (Limbe, Cameroon), *Nocticanace littorea* (Takaungu, 50 km N Mombasa, Kenya), *Procanace canzonerii* (Limbe and Kribi, Cameroon), and *Procanace pninae* (Takaungu, 50 km N Mombasa, Kenya). One synonymy is proposed: *Procanace fluvialis* Canzoneri, 1987 = *Procanace grisescens* Hendel, 1913. Diagnoses are provided for species groups and genera that include new species to facilitate their recognition.

Key Words: Canacidae (Canacini, Nocticanacinae), beach flies, Afrotropical Region, taxonomic review

Recent collecting in Cameroon and Kenya has resulted in specimens of the dipterous family Canacidae that are new or little known from the Afrotropical Region. This paper reports the study of this material within the context of a review of the tribe Canacini (subfamily Canacinae) and the subfamily Nocticanacinae from the Afrotropical Region. All of the new species described herein belong to genera that are included in Canacini or Nocticanacinae, and the latter has never been treated comprehensively except for a listing of species in the recent catalog of Afrotropical Diptera (Cogan 1980). Since publication of this catalog, additional Afrotropical species have been added to Canacini (Canzoneri 1981, 1982) and Nocticanacinae (Canzoneri 1987, Canzoneri and Raffone 1987, Mathis 1988b). This treatment of Canacini and Nocticanacinae completes review of all known species of Afrotropical beach flies.

Previously, Mathis (1982a) reviewed the tribe Dynomiellini (subfamily Canacinae), the only other tribe of beach flies known to occur in the Afrotropical Region.

For each genus and species that is reviewed, a synonymy, the known distribution, including detailed information on the type locality, the depository of the primary types, and a remarks section, as appropriate, are provided. In the synonymies, only literature that is pertinent to the Afrotropical Region or the taxons' nomenclatural history is cited. For new species, a more complete description is provided, including diagnoses of appropriate species groups and genera. The species groups that are recognized for the genera *Nocticanace* and *Procanace* are not necessarily monophyletic assemblages and are used primarily to conveniently divide the genera into manageable units and to facilitate their identification. Their characterization and species composition may

change as a result of revisionary studies. The descriptive format for the new species follows Mathis and Wirth (1979) and Mathis (1982a, 1988a). More details concerning the morphology and higher classification of Canacidae are found in Mathis (1982a) and Wirth (1987).

Two venational ratios are used in the descriptions. Costal Vein Ratio: The straight line distance between the apices of R_{2+3} and R_{4+5} /distance between the apices of R_1 and R_{2+3} . M Vein Ratio: The straight line distance along vein M between crossveins (dm-cu and r-m)/distance apicad of dm-cu.

Amnon Freidberg and Fini Kaplan, Tel-Aviv University (TAU), Israel, collected the specimens from Cameroon, Kenya, and Nigeria, and these collections are deposited in TAU and the National Museum of Natural History (USNM), Smithsonian Institution. Acronyms of other institutions, primarily those where primary types are deposited, are as follows: DCSA (Dipterorum Collectionis Strobl, Admont, Austria), BBM (Bernice P. Bishop Museum, Honolulu, Hawaii), BMNH (British Museum (Natural History), London), HUS (Hokkaido University, Sapporo, Japan), MCV (Museo Civico di Storia Naturale di Venezia, Italy), MNHN (Muséum National d'Histoire Naturelle, Paris, France), NMW (Naturhistorisches Museum, Wien, Austria), TMC (Transvaal Museum Collection, Pretoria, South Africa), ZMA (Instituut voor Taxonomische Zoologie, Zoologisch Museum, Universiteit van Amsterdam, Netherlands).

- lamella of ♀ terminalia with 1 large, apical seta, this usually acutely pointed (Subfamily Canacinae) 3
- 2. Intrafrontal setae absent, although anterior 1/3 of frons occasionally with scattered setulae ... *Procanace* Hendel [6 species in the Afrotropical Region]
- One or 2 intrafrontal setae in addition to setulae, if any *Nocticanace* Malloch [6 species in the Afrotropical Region]
- 3. Laterocline fronto-orbital setae 3; katepisternal seta lacking (Tribe Canacini) *Canace* Haliday [3 species in the Afrotropical Region]
- Laterocline fronto-orbital setae 4 or more; katepisternal seta sometimes present (Tribe Dynomiellini) 4
- 4. Katepisternal seta present, sometimes pale ... *Isocanace* Mathis [3 species in the Afrotropical Region; Mathis, 1982a: 11-20]
- Katepisternal seta absent 5
- 5. Anterior notopleural seta lacking; lateral scutellar setae 1 pair *Trichocanace* Wirth [1 species in the Afrotropical Region, *T. sinensis* Wirth; Madagascar; Mathis, 1982a: 22]
- Anterior notopleural seta present; lateral scutellar setae 2 pairs 6
- 6. Vein M with last section arcuate; mesofrons uniformly and densely setulose; fronto-orbital setae 4-6; setae in general pale *Xanthocanace* Hendel [1 species in the Afrotropical Region, *X. capensis* Wirth; South Africa; Mathis, 1982a: 24]
- Vein M with last section more or less straight, not distinctly arcuate; mesofrons with bare areas, not densely setulose; fronto-orbital setae 4; setae in general dark colored *Dynomiella* Giordani Soika [4 species in the Afrotropical Region (South Africa or Namibia); Mathis, 1982a: 9-11]

ANNOTATED KEY TO SUBFAMILIES,
TRIBES, AND GENERA OF
AFROTROPICAL CANACIDAE

- 1. Laterocline fronto-orbital setae 3 and katepisternal seta usually present (lacking in the *griescens* group of *Procanace*); lamella of ♀ terminalia bearing 2 large setae, one apical the other subapical, each rather bluntly rounded (Subfamily Nocticanacinae) 2
- Laterocline fronto-orbital setae either 4 or more, or 3 and with katepisternal seta lacking;

SUBFAMILY CANACINAE
TRIBE CANACINI
GENUS *CANACE* HALIDAY

Canace Haliday, in Curtis, 1837: 281 [published in synonymy; first made available by use in Haliday, 1839: 411]. Type species: *Ephydra nasica* Haliday, 1839, by subsequent monotypy (Haliday, 1839: 411).—Mathis, 1982b: 58 [revision, figs. of heads and ♂ and ♀ terminalia].

Diagnosis.—*Head*: Mesofrons with 1–4 marginal, generally proclinate setae; post-ocellar setae, 1 pair, large (subequal in size to ocellar setae), divergent (with same orientation as ocellar setae); mesofrons densely microtomentose, usually appearing dull, vestiture not markedly differentiated from that of parafrons; large, latero-clinate, fronto-orbital setae 3; arista with branching hairs short, not longer than basal arista width, and extended nearly to tip; large, anaclinate, genal setae 2–4; large, antero-clinate, genal setae 1–2; eye longer than high.

Thorax: Dorsocentral setae 4 (1+3); acrostichal setulae generally evident as 2 rows though setulae sometimes weakly developed or with additional setae between acrostichal and dorsocentral setae anteriorly; prescutellar acrostichal setae well developed; supra-alar setae 1 (posterior); scutellum usually with sparse discal setulae and 2 pairs of lateral setae; notopleural setae 2; anepisternum usually with 2 large setae of subequal length along posterior margin, occasionally 3, also with a distinctive, anaclinate seta inserted near posterodorsal angle; both proepisternum and proepimeron bearing a seta; katepisternum lacking a large seta, although usually with some setulae, especially toward ventral margin. Apical section of vein M straight. Femora dark colored; fore femur subequal in size to middle and hind femora, bearing 3–5 long, slender, posteroventral setae, but lacking short, stout, anteroventral setae; hind tibia lacking an anteroventral, spinelike seta apically.

Abdomen: Male terminalia: Surstylus in lateral view with fingerlike, ventral projection and frequently with an enlarged, posteroventral process. Female genital lamellae slender, terminal setae long, slender, usually acutely pointed.

Discussion.—*Canace* is an Old-World genus and is only known to occur along the coasts of the North Sea and north Atlantic, the Mediterranean Sea, and west Africa (south Atlantic coast).

We have collected larvae and reared adults

of *C. salonitana*. The larvae occurred on the protected sides of large rocks along the coast of the Mediterranean Sea in Israel. The rocks, to varying degrees, were covered with algae, which is probably the food source for both larvae and adults.

The key includes all known species of *Canace*, as all but two of these, *C. salonitana* (Mediterranean) and *C. actites* (Canary and Madeira islands), are now known from the Afrotropical Region.

KEY TO SPECIES OF *CANACE*

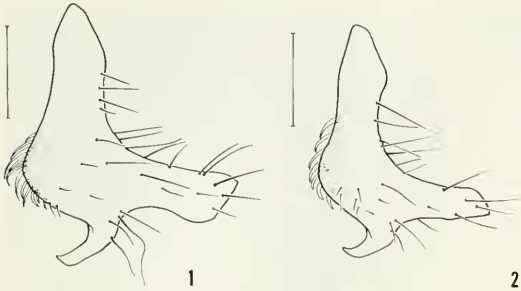
1. Gena with 3–4 large, anaclinate setae below eye 2
- Gena with 2 large, anaclinate setae below eye 3
2. Posterior process of surstylus robust, slightly enlarged subapically *C. nasica* (Haliday)
- Posterior process of surstylus generally thinner and gradually becoming narrower toward apex *C. rossii* Canzoneri
3. Mesofrons with 3–4 pairs of proclinate setae inserted along margin anterior of median ocellus; anterior acrostichal setae well developed, conspicuous; larger species, length 2.5 to 3.3 mm *C. salonitana* Strobl
- Mesofrons with 1–2 pairs of proclinate setae inserted along margin; anterior acrostichal setae weak, inconspicuous, smaller species, length 1.5 to 3.1 mm 4
4. Mesofrons with 2 pairs of proclinate setae, posterior seta inserted about in line with posterior ocelli, anterior seta inserted in line with median ocellus; anterior margin of gena bearing 2 large, antero-clinate setae *C. zivvi*, new species
- Mesofrons with 1 pair of proclinate setae, these inserted in line with median ocellus; anterior margin of gena bearing 1 large, antero-clinate seta *C. actites* Mathis

Canace nasica (Haliday)

Fig. 1

Ephydra (*Canace*) *nasica* Haliday, 1839: 411.

Canace nasica.—Loew, 1860: 29 [generic combination, review].—Frey, 1958: 48 [list, Cape Verde Islands].—Cogan, 1980: 694 [Afrotropical catalog].—Canzoneri, 1981: 216 [list, Senegal].—Mathis, 1982b: 60 [revision, figs. of head, ♂ and ♀ terminalia].



Figs. 1, 2. Posterior surstylar process. 1, *Canace nasica*, lateral view; 2, *Canace rossii*, lateral view. Scale bar equals 0.1 mm.

Distribution.—Afrotropical: Cape Verde Islands (Frey 1958), and Senegal (Dakar, N'Gor; Canzoneri 1981). Palearctic: Coast of the North Sea, Mediterranean, and islands of eastern Atlantic Ocean (Azores, Canary Islands, and Madeira Islands).

Type material.—Primary types apparently lost (see Mathis 1982b: 60).

Remarks.—Specimens from the two Afrotropical localities noted above (Cape Verde Islands and coast of Senegal) have not been examined, and their identity remains unconfirmed. We would not be surprised to discover that the Afrotropical specimens are representatives of *C. rossii*.

Comparison of *C. nasica* (two sites in England) and a paratopotype of *C. rossii* revealed slight differences in the shape of the male terminalia, especially the posterior surstylar process (Figs. 1, 2). This process, in specimens from England (and presumably from Ireland, the type locality of this species), is slightly more robust than in specimens from Sierra Leone and has a slight, subapical swelling. We also studied specimens from Cameroon and found the posterior process to be very similar to that from Sierra Leone. Although the differences are slight, they are consistent in the sampling we were able to study, and we have elected to recognize the variation between populations from northern European and those from western Africa as interspecific. Much better sampling from several sites between

these rather disjunct localities is needed to test this hypothesis further, specifically whether the variation is intraspecific, perhaps clinal, or whether the differences we found are consistent and represent independent lineages.

Canace rossii Canzoneri
Fig. 2

Canace rossii Canzoneri, 1982: 61.

Distribution.—Sierra Leone, Western Area, Freetown (Lumley Beach di fronte a Juba.) and Cameroon (Kribi).

Type material.—Holotype ♂, MCV.

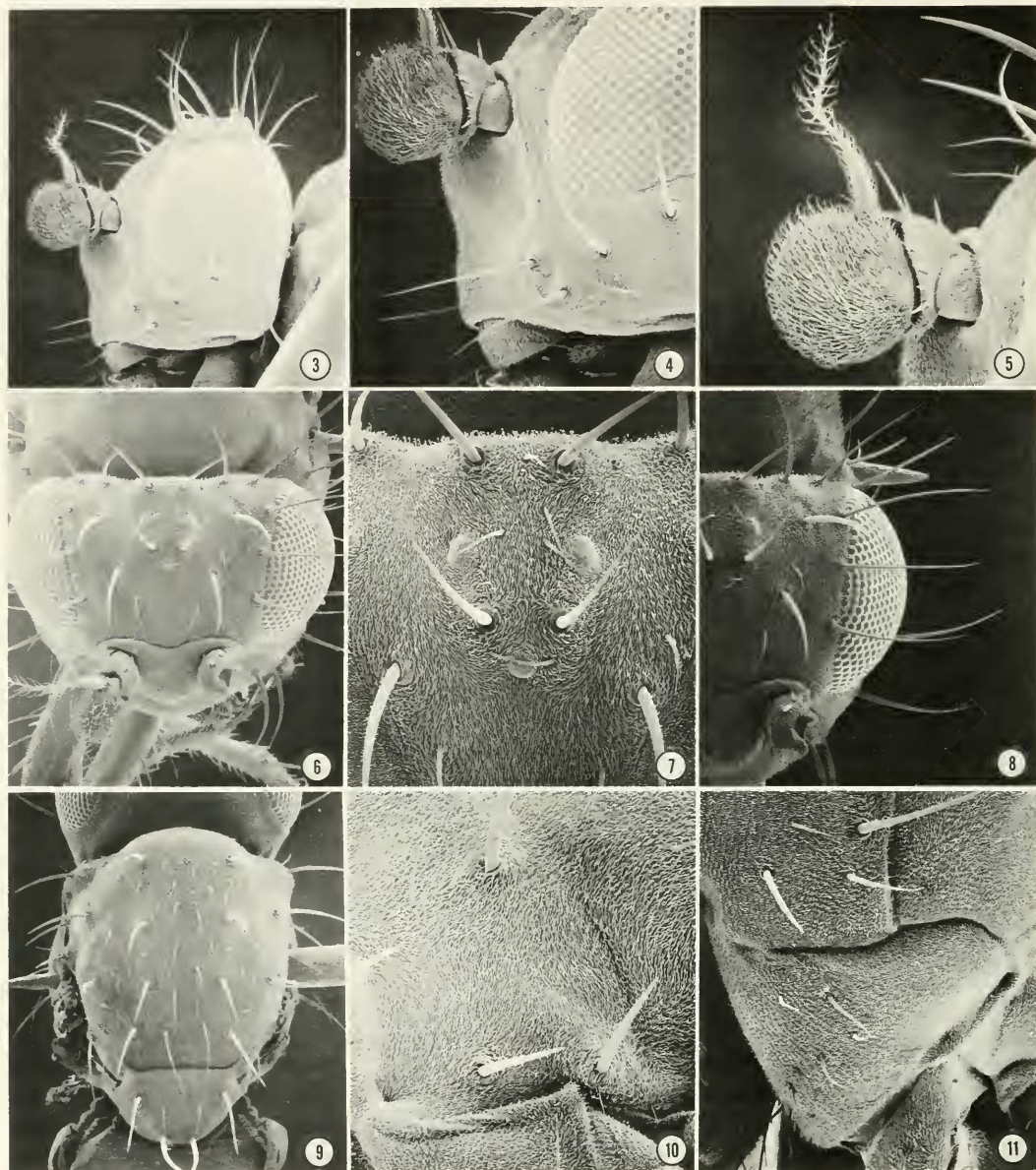
Remarks.—See our comments under the "Remarks" section of the previous species.

Canace zvyu Mathis and Freidberg,
NEW SPECIES
Figs. 3–12

Description.—Small to moderately small beach flies, length 1.80 to 2.20 mm; mostly dark colored, brown to grayish brown.

Head (Figs. 3–8): Eye with oblique orientation; anterodorsal portion of head, near juncture with antenna, less protrudent or angulate; frons with mesofrons and fronto-orbits similar, dark brown with some bronzy tinges, contrasted with charcoal-colored, dull parafrons; frons bearing 2 large, marginal setae and 1 anterior setula (less than ½ length of larger setae), 2 larger setae inserted more or less in line with posterior ocelli (posterior seta) and median ocellus (anterior seta), setula inserted between anterior margin of frons and median ocellus; gena with 2 subequal, anaclinate setae just below the eye and 2 anteroclinate setae toward the anterior margin, one seta inserted at anterior margin, the other slightly posteroventrad; face and gena silvery gray.

Thorax (Figs. 9–11): Acrostichal setulae sparse and mostly weakly developed, occasionally with a few larger setulae; disc of scutellum either bare of setulae or with 1–2. Wing with costal vein ratio averaging 0.10; vein M ratio averaging 0.62.



Figs. 3–11. Scanning electron stereomicrographs of *Canace zvu*. 3, Head, lateral view; 4, Gena and setae, lateral view; 5, Antenna, lateral view; 6, Frons, dorsoblique view; 7, Ocellar triangle and setae, dorsoblique view; 8, Fronto-orbits and setae, dorsal view; 9, Mesonotum, dorsal view; 10, Notopleuron and setae, lateral view; 11, Katapisternum and setulae, lateral view.

Abdomen: Male terminalia (Fig. 12): Surstylus broadly L-shaped and with an anteroventral, fingerlike process; anterior margin of surstylus just below midheight bearing several longer setulae.

Type material—The holotype male is labeled "CAMEROON Limbe (shore) 14–15.XI[Nov].1987 A. FREIDBERG." The allotype female and paratypes (5 ♂, 14 ♀; TAU, USNM) bear the same locality data

as the holotype; Fini Kaplan, Tel-Aviv University, was the collector of six of the female paratypes. The holotype is double mounted (minute nadel in a polyporus block), is in excellent condition, and is deposited in the USNM.

Natural history.—The type series was collected along the coast of Cameroon at a site just west of Limbe. The site was a polluted (tar), sandy beach with large, flat rocks among small, intertidal pools. The large rocks extended onto the sandy shore. The flies were collected by sweeping an aerial net against or just above the rocks.

Etymology.—The specific epithet, *zvuv*, is a noun in apposition and is the transliteration of a Hebrew noun from the Bible meaning fly and is so named to recognize the collecting efforts of Israeli entomologists, who collected the type series.

Remarks.—Externally this species is similar to *C. actites* and *C. salonitana* but differs in the number and orientation of setae on the mesofrons and gena. The shape of the male terminalia also differs, especially that of the surstylus, which is broadly L-shaped as in *C. salonitana* but bears an anterovenral, rather sharply pointed process (the process is bluntly rounded in *C. salonitana* and has a more ventral orientation).

SUBFAMILY NOCTICANACINAE
GENUS *NOCTICANACE* MALLOCH

Nocticanace Malloch, 1933: 4. Type species: *N. peculiaris* Malloch, by original designation.—Mathis, 1989: 594 [key to species groups].

Diagnosis.—Small to medium-sized beach flies, length 1.8 to 3.7 mm; general coloration grayish black.

Head: Intrafrontal setae 1 pair; postocellar setae either absent or much reduced, less than $\frac{1}{4}$ length of ocellar setae; ocelli arranged to form an isosceles triangle, distance between posterior ocelli greater than that between either posterior ocellus and the anterior ocellus. Lower facial margin sinuate; clypeus low,



Fig. 12. *Canace zvuv*. Male terminalia (epandrium, cerci, and surstylus), lateral view. Scale bar equals 0.1 mm.

width subequal to length of antenna. Two large anaclinate genal setae; anteroclinate genal seta moderately well developed, at least $\frac{1}{2}$ length of larger anaclinate genal setae. Palpus grayish black, bearing 1 to several long setae, each seta 2 to 3 times as long as greatest width of palpus.

Thorax: Anepisternum with scattered setulae; proepisternal seta absent; katepisternal seta present, well developed. Legs entirely dark colored, grayish black; fore femur bearing 4–6 long and evenly spaced setae along posteroventral margin, length of setae at least equal to and usually greater than width of femur.

Discussion.—The species-group key, which follows, is essentially that of Mathis (1989) but with minor changes. In preparing the key, one of us (WNM) examined most species of the genus. The key, however, should still be considered preliminary, and we invite the critique and comment of users. The Afrotropical species all belong to the *pacifica* group, which is distinguished from other species groups by the characters outlined in the species-group key and diagnosis that follow.

ANNOTATED KEY TO SPECIES
GROUPS OF THE GENUS *NOCTICANACE*

1. Anterior notopleural seta absent 2
- Anterior notopleural seta present 3

2. Apical scutellar setae distinctly curved anaclinate the *pacifica* group
[20 species; Old World, Pacific and Indian Oceans, especially Oceania]
- Apical scutellar setae straight to very slightly curved the *texensis* group
[3 species; Caribbean, Gulf of Mexico, Atlantic coast of southeastern United States; revised by Mathis 1989: 594–599]
3. Length of apical section of vein CuA₁ twice or more length of crossvein dm-cu the *galapagos* group
[8 species; Galápagos Islands and southwestern North America]
- Length of apical section of vein CuA₁ subequal to length of crossvein dm-cu 4
4. Apical scutellar setae distinctly anaclinate the *ashlocki* group
[1 species, *N. ashlocki* Wirth; Galápagos Islands]
- Apical scutellar setae not anaclinate the *chilensis* group
[1 species, *N. chilensis* (Cresson); Chile (there are numerous undescribed species in this group)]

THE *PACIFICA* GROUP

Diagnosis.—Coloration generally dark, grayish brown to grayish black but with exceptions (*N. flavipalpis* and *N. littorea*) that are lighter, with some tan coloration on the body and legs extensively yellowish.

Thorax: Acrostichal setulae absent; apical scutellar setae distinctly anaclinate; anterior notopleural seta absent; proepisternal seta(e) present; anepisternum with scattered setulae; katepisternal seta present. Legs usually entirely dark, grayish brown to black (*N. flavipalpis* and *N. littorea* are exceptions with legs that are mostly yellowish); fore femur with 4–6 long and evenly spaced setae along posteroventral margin, length greater than width of femur; midfemur of male lacking a comblike row of setae; hindtibia lacking spinelike setae apically. Wing with length of apical section of vein CuA₁ long, about twice length of crossvein dm-cu; vein M index 0.44.

KEY TO AFROTROPICAL SPECIES OF THE *PACIFICA* GROUP OF *NOCTICANACE*

1. Tarsi, apices of tibiae, femora, and palpus yellowish 2
- Legs and palpus entirely dark colored, mostly gray to blackish gray 3
2. Posterior surstylar lobe less broadly developed, median portion narrower than digitiform apex *N. flavipalpis* Mathis and Wirth
- Posterior surstylar lobe more broadly developed (Fig. 13), median portion wider than digitiform apex *N. littorea*, new species
3. Granitic Seychelles *N. mahensis* (Lamb)
- Malagasy subregion, Aldabra, Kenya, and South Africa 4
4. Dark coloration of scutum extended ventrally no farther than dorsal half of notopleuron, ventral portion whitish gray *N. cyclura* Mathis and Wirth
- Dark grayish-brown coloration of scutum extended ventrally at least to dorsal half of anepisternum 5
5. Surstylus emarginate ventrally, not deeply cleft, single lobe becoming wider ventrally to subapical widest point, thereafter narrowed gradually to broad, emarginate, ventral margin *N. actites* Mathis and Wirth
- Surstylus deeply cleft ventrally, posterior lobe slender, digitiform, width less than half anterior lobe, pointed apically; anterior lobe broad, parallel sided, broadly rounded apically *N. caffraria* (Cresson)

Nocticanace actites Mathis and Wirth

Nocticanace actites Mathis and Wirth, 1979: 790. — Mathis, 1988b: 24 [list, Aldabra (? identification)].

Distribution.—Madagascar. Fenerive (on beach), Est: dct Mananara, Ivontaka (15 m). Seychelles. Aldabra (Malabar: Passe Houareau; Picard: Settlement).

Type material.—Holotype ♂, MNHN.

Nocticanace caffraria (Cresson)

Canaceoides caffraria Cresson, 1934: 222. *Nocticanace caffraria*. — Wirth, 1951: 273 [revision, generic combination]; 1956: 51 [review]. — Cogan, 1980: 694 [Afrotropical catalog].

Distribution.—South Africa. Cape Prov-

ince: East London, Plettenberg. Natal Province: Umkomaas (beach).

Type material.—Holotype ♂, TMC.

Nocticanace cyclura
Mathis and Wirth

Nocticanace cyclura Mathis and Wirth, 1979: 791.

Distribution.—Madagascar. Sud-Est: dct Fort-Dauphin, Sainte-Luce (10 m); Fenerive (on beach).

Type material.—Holotype ♂, MNHN.

Nocticanace flavipalpis
Mathis and Wirth

Nocticanace flavipalpis Mathis and Wirth, 1979: 792.—Mathis, 1988b: 23 [list, Aldabra, Cosmoledo].

Distribution.—Madagascar. Est: dct Mananara, Ivontaka (15 m); Seychelles: Aldabra (Grande Terre: Dune Jean-Luis), Cosmoledo (Menai Island: Station).

Type material.—Holotype ♂, MNHN.

Nocticanace littorea
Mathis and Freidberg,

NEW SPECIES

Fig. 13

Description.—A small, light-colored, beach-fly species of the *pacifica* group (see key to species groups), length 1.7 to 1.9 mm.

Head: Grayish coloration of face and gena lighter, mostly whitish gray. Palpus yellowish.

Thorax: Brown coloration of mesonotum extended laterally and ventrally to about dorsum of notopleuron, thereafter gradually becoming more whitish gray with some very faint greenish tinges. Pleural areas mostly whitish gray. Legs concolorous, mostly yellowish; dorsum of femur and to a lesser extent tibia somewhat microtomentose, lightly grayish.

Abdomen: Dorsum mostly grayish; median portion of each tergum with some brownish-purple coloration, lateral margins often faintly bluish gray. Male terminalia

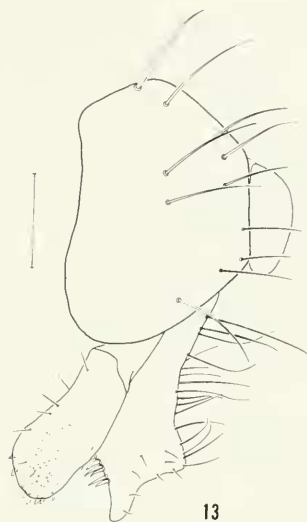


Fig. 13. *Nocticanace littorea*. Male terminalia (epandrium, cerci, and surstylus), lateral view. Scale bar equals 0.1 mm.

(Fig. 13): Surstylus deeply cleft ventrally, with a distinct anterior and posterior lobe; anterior lobe moderately slender and long, medial surface bearing numerous, short, stout setae on ventral half; posterior lobe with median portion conspicuously swollen before much more narrowed apex, antero-ventral margin, especially medial aspect, bearing 5–6 stout setae.

Type material.—Holotype ♂ is labeled “KENYA Takaungu, 50 Km North Mombasa 3. XII. 1989 [3 Dec 1989] A. FREIDBERG & FINI KAPLAN.” Five paratypes (2 ♂, 3 ♀; USNM) bear the same label data as the holotype. The holotype is double mounted (minute nadel in a plastic block), is in good condition (slightly teneral), and is deposited in the USNM.

Natural history.—The type locality is a wooded estuary, known by the inhabitants of the village as “The Creek,” which is drained of sea water during low tide. During high tide the shore is a mixture of sand with small stones. Beach and shore flies were abundant along the high-water line and on an artificial wall, which was nearby.

Etymology.—The species epithet, *litto-*

rea, is a Latin adjective, meaning "pertaining to the seashore," and its usage here alludes to the habitat where this species was collected.

Remarks.—This species is very similar to *N. flavipalpis* and the two are distinguished from other Afrotropical congeners by the yellowish palpus, front trochanter, tarsi and apex of femora, particularly the ventral surface of the latter; brown coloration of mesonotum extended lateroventrally no farther than dorsal angle of notopleuron; surstylus deeply cleft ventrally, forming a distinct anterior and posterior lobe; posterior lobe, in lateral view with apex digitiform; anterior lobe in lateral view more or less parallel sided ventrally, median surface bearing numerous spinelike setulae. This species is distinguished from *C. flavipalpis* by the shape of the surstylar lobes: posterior lobe more broadly developed in lateral view, appearing conspicuously swollen subapically; anterior lobe more slender, appearing longer.

Nocticanace mahensis (Lamb)

Canace mahensis Lamb, 1912: 328.

Nocticanace mahensis.—Wirth, 1951: 274 [generic combination].—Cogan, 1980: 694 [catalog].—Mathis, 1982c: 423 [review, figs. of δ terminalia].—Mathis, 1988b: 23 [list, Mahé].

Distribution.—Seychelles. Mahé: Long Island; Anse aux Pins, Anse Royale Bay, Anse Takamaka, Bel Ombre, Coevity, Machabee, Port Launay.

Type material.—Holotype \varnothing , BMNH.

Genus *Procanace* Hendel

Procanace Hendel, 1913: 93. Type species: *Procanace grisescens* Hendel, by original designation].—Mathis and Wirth, 1979: 794 [diagnosis and discussion].—Mathis, 1988a: 330 [diagnosis and key to species groups].

Diagnosis.—General coloration whitish gray, olivaceous, to blackish brown.

Head: Intrafrontal setae absent, but with

a few setulae inserted anteriorly; fronto-orbital setae 3; ocelli arranged to form equilateral or isosceles triangle, if isosceles, the greater distance is between posterior ocelli. Arista bearing tiny hairs over entire length, appearing macropubescent. Large anaclinate genal setae 2; anteroclinate genal seta moderately well developed. Palpus not bearing long setae. Lower facial margin, in lateral view, more or less horizontal.

Thorax: Acrostichal setae usually lacking (setulae present in species of the *williamsi* group); scutellar disc lacking setae (1–2 pairs of scutellar disc setulae occur in *P. nakazatoi* Miyagi of the *williamsi* group); marginal scutellar setae 2, apical pair not anaclinate; supra-alar seta 1 (posterior); anterior and posterior notopleural setae present, length subequal; anepisternum with scattered setulae and 1 large seta along the posterior margin, lacking a prominent, anaclinate seta inserted near posterodorsal angle. Katepisternal seta usually present (lacking in species of the *grisescens* group). Apical section of vein M straight. Femora pale colored (dark colored in some species groups); fore femur subequal in size to middle and hind femora, lacking posteroventral setae; hind tibia lacking spinelike setae apically.

Abdomen: Male terminalia as follows: Epandrium in posterior view wider than high; cerci reduced, poorly sclerotized; surstylus with an anterior and posterior lobe, the latter larger, sometimes markedly so and shape unique to species.

Discussion.—The Afrotropical species of *Procanace* are assigned to two species groups: the *fulva* group, with two species, and the *grisescens* group, with three species. These two groups are distinguished by the characters outlined in the species-group key and diagnosis, which follow.

ANNOTATED KEY TO SPECIES GROUPS OF *PROCANACE* HENDEL

1. Katepisternal seta absent . . . the *grisescens* group
[5 species; Oriental, eastern Palearctic, Oceanian, Malagasy, Kenya, Seychelles]

- Katepisternal seta present 2
- 2. Clypeus high, width about twice height; palpus blackish brown; proepisternal seta absent ...
..... the *nigroviridis* group
[7 species; Hawaiian Islands]
- Clypeus low, width at least 4 times height; palpus yellowish; proepisternal seta(e) present ... 3
- 3. Acrostichal setulae present, in 2 irregular rows
..... the *williamsi* group
[4 species; Hawaiian and Ryukyu Islands]
- Acrostichal setulae absent 4
- 4. Postocellar setae either absent or much reduced
..... the *fulva* group
[11 species; Oriental, eastern Palearctic, and Afrotropical]
- Postocellar setae present, subequal to length of ocellar seta the *cressoni* group
[3 species; Oriental, Nearctic]

THE *FULVA* GROUP

Diagnosis.—Generally whitish olivaceous to brown.

Head: Postocellar setae either absent or much reduced; ocelli arranged to form equilateral triangle. Palpus yellow. Clypeus low, height $\frac{1}{3}$ to $\frac{1}{4}$ width.

Thorax: Acrostichal setulae absent; proepisternal seta(e) present; anepisternum with scattered setulae; katepisternal seta present. Femora and tibiae mostly yellowish but with considerable grayish microtomentum; tarsi yellowish, becoming darker apically; fore femur lacking long, evenly spaced setae along posteroventral margin, length of setae that are present equal or less than width of femur; middle femur of δ bearing comblike sparse row of setae. Wing with apical section of vein CuA₁ short, subequal to or slightly longer than crossvein dm-cu; vein M index averaging 0.57.

Discussion.—The *fulva* group, as presently characterized, comprises 11 species that occur on beaches around and within the Pacific and now the Indian and Atlantic Oceans. The specimens from Cameroon and Kenya represent the first known departures from the Australasian and Oceanian Regions. Disjunct distributions sometimes indicate that a taxon may be paraphyletic, a possibility that should be considered when this group is studied further.

KEY TO AFROTROPICAL SPECIES OF THE *FULVA* GROUP

- 1. Legs entirely yellow except for apical 1–2 tarsomeres; male terminalia as in Figs. 25–26 ...
..... *P. pniae*, new species
- Legs mostly yellowish but with some olivaceous coloration; male terminalia as in Figs. 23–24 *P. canzonerii*, new species

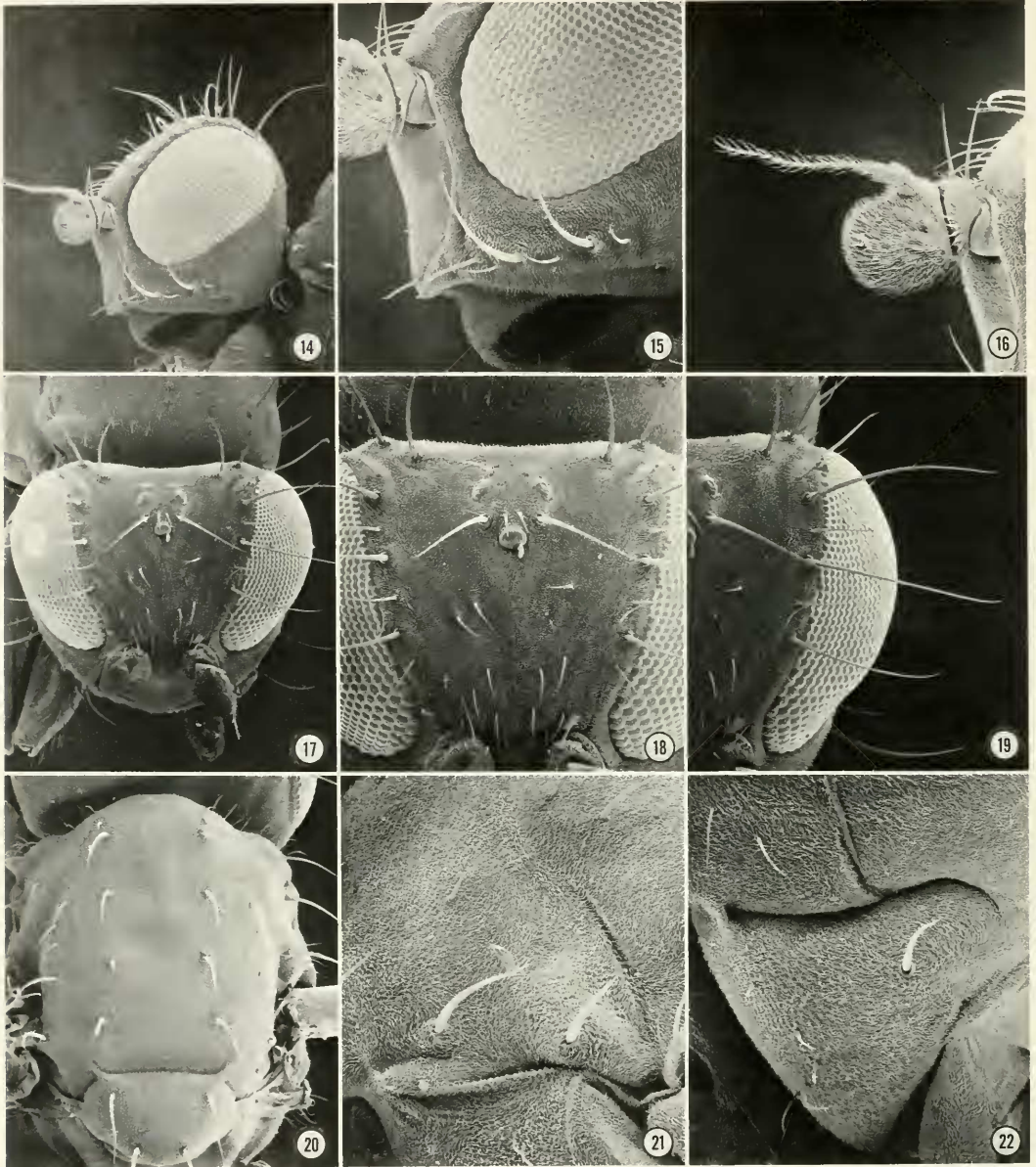
Procanace canzonerii
Mathis and Freidberg,
NEW SPECIES
Figs. 14–24

Description.—Small to moderately small beach flies, length 1.90 to 2.40 mm; thorax and head generally brown to grayish brown dorsally, becoming lighter ventrally, abdomen mostly gray to blackish gray.

Head (Figs. 14–19): Frons lacking a differentiated mesofrons and parafrons, mostly appearing dull, grayish charcoal, with some brownish coloration around anterior margin of ocellar triangle and at anterior margin; 2–6 setulae inserted between ocellar triangle and anterior margin; postocellar setae much reduced, at most $\frac{1}{3}$ length of ocellar setae; fronto-orbits slightly more grayish, becoming whitish anterior of fronto-orbital setae. Scape and pedicel blackish; 1st flagellomere mostly blackish but distinctly yellowish orange basomedially. Face and gena mostly whitish gray; parafacials with some brownish to yellowish brown coloration adjacent to eye. Gena with 2 large, anaclinate setae and 1 large, anteroclinate seta; eye-to-cheek ratio averaging 0.35.

Thorax (Figs. 20–22): Third dorsocentral seta inserted slightly medially from alignment of 2nd and 4th setae. Legs mostly yellowish; femora and tibiae with whitish gray microtomentum invested on anterior and dorsal surfaces; apical 2–3 tarsomeres becoming darker brown; middle femur of male with 4–5 black setae inserted posteroventrally about $\frac{1}{3}$ from apex. Wing with costal vein ratio averaging 0.21; vein M ratio averaging 0.56.

Abdomen: Male terminalia (Figs. 23–24):

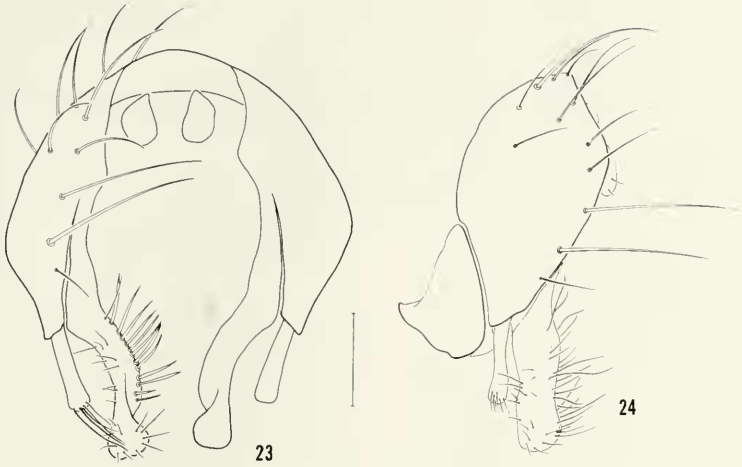


Figs. 14–22. Scanning electron micrographs of *Procanace canzonerii*. 14, Head, lateral view; 15, Gena and setae, lateral view; 16, Antenna, lateral view; 17, Frons, dorsoblique view; 18, Ocellar triangle and setae, dorsoblique view; 19, Fronto-orbits and setae, dorsal view; 20, Mesonotum, dorsal view; 21, Notopleuron and setae, lateral view; 22, Katapisternum and setulae, lateral view.

Posterior surstylar lobe much larger than anterior lobe, bluntly rounded ventrally and bearing numerous setulae, many of which, including those at distal half of lobe, longer than lobe's width; anterior lobe less than $\frac{1}{2}$

width of posterior lobe, but slightly more than $\frac{1}{2}$ length, apex bearing several setulae.

Type material.—The holotype male is labeled "CAMEROON Limbe (shore) 14–15.XI.[NOV]1987 A. FREIDBERG." The



Figs. 23, 24. Male terminalia of *Procanace canzonerii*. 23, Epandrium, cerci, and surstyli, posterior view; 24, Epandrium, cercus, and anterior and posterior surstyler processes, lateral view. Scale bar equals 0.1 mm.

allotype female and 66 paratypes (25 ♂, 41 ♀; TAU, USNM) bear the same locality data as the holotype (12 specimens were collected by Fini Kaplan). An additional 32 paratypes (15 ♂, 17 ♀; TAU, USNM) are from: Cameroon. Kribi (beach), route N7, 28–29 Nov 1987, A. Freidberg, F. Kaplan. The holotype is double mounted (minute nadel in polyporus block), is in excellent condition, and is deposited in the Smithsonian Institution (USNM).

Natural history.—The specific habitat at the type locality comprised fist-sized cobble at the mouth of a river, which was in the middle of Limbe. The cobble was largely bare, perhaps scoured by floods, but some algae was found on an adjacent site downstream. Although the cobble habitat appeared relatively sterile, the flies were abundant.

At Kribi, the habitat comprised a narrow sand beach, which was margined by *Ipomoea* sp. (Ipomoeaceae), with occasional concentrations of intertidal rocks, which was where most of the flies were collected.

Etymology.—The specific epithet, *canzonerii*, is a patronym to honor Mr. Silvano Canzoneri, who has contributed much to our understanding of beach flies from the Afrotropical Region.

Remarks.—The only other Afrotropical species of the *fulva* group is the next species, which is also new. This species is distinguished by the slightly darker legs and the shape of the male terminalia, especially the more bluntly rounded posterior surstyler process (lateral and posterior views).

Procanace pninae
Mathis and Freidberg,
 NEW SPECIES
 Figs. 25, 26

Description.—Small beach flies, length 1.65 mm; thorax and head generally brown to grayish brown dorsally, becoming lighter ventrally, abdomen mostly gray to blackish gray.

Head: Frons lacking a well-differentiated mesofrons and parafrons, mostly microtomentose, appearing dull, gray, with some yellow to brownish coloration at anterior ¼; 2–6 setulae inserted between ocellar triangle and anterior margin; postocellar setae much reduced, at most ⅓ length of ocellar setae; fronto-orbits slightly lighter, more whitish, becoming orangish at level of pitilinal suture. Scape and pedicel blackish; 1st flagellomere mostly blackish but distinctly yellowish orange basomedially. Face and gena mostly whitish gray; parafacial with consid-



Figs. 25, 26. Male terminalia of *Procanace puinae*. 25, Epandrium, cerci, and surstyli, posterior view; 26, Epandrium, cercus, and anterior and posterior surstyliar processes, lateral view. Figs. 27, 28. Male terminalia of *Procanace cogani*. 27, Epandrium, cerci, and surstyli, posterior view; 28, Epandrium, cercus, and anterior and posterior surstyliar processes, lateral view. Scale bar equals 0.1 mm.

erable orangish to yellowish brown coloration adjacent to eye. Gena with 2 large, anacinate setae and 1 large, anteroclinate seta; eye-to-cheek ratio averaging 0.32.

Thorax: Third dorsocentral seta inserted slightly mediad from alignment of 2nd and 4th setae. Legs mostly yellowish; femora and tibiae with whitish microtomentum thinly invested on anterior and dorsal surfaces; apical 2-3 tarsomeres becoming darker brown; middle femur of male with 3-4 black setae inserted posteroventrally about $\frac{1}{3}$ from apex. Wing with costal vein ratio 0.22; vein M ratio 0.60.

Abdomen: Male terminalia (Figs. 25, 26):

Posterior surstyliar lobe much larger than anterior lobe, narrowed towards venter and bearing numerous setulae; anterior lobe less than $\frac{1}{2}$ width of posterior lobe, but slightly more than $\frac{3}{4}$ length in lateral view, apex slightly swollen and bearing several setulae.

Type material. — The holotype male is labeled "KENYA Takaungu, 50 Km North Mombasa 3. XII. 1989 [3 Dec 1989] A. FREIDBERG & FINI KAPLAN." The holotype is double mounted (minute nadel in plastic block), is in good condition (the abdomen has been removed and dissected, the parts are in an attached microvial, the legs and wing on the right side have been re-

moved and are glued to the plastic block), and is deposited in the Smithsonian Institution (USNM).

Natural history.—See comments under *Nocticanace littorea*.

Etymology.—The species epithet, *pninae*, is a genitive patronym to recognize the support of Pnina Freidberg to her husband's study of Diptera, especially his field work in Africa and elsewhere.

Remarks.—The lighter colored legs, entirely yellowish with a thin investment of whitish microtomentum on the dorsum of the femora, and the shape of the male terminalia, especially the posterior surstylar process (lateral and posterior views), distinguish this species from congeners.

THE *GRISESCENS* GROUP

Remarks.—Three species of the *grise-cens* group are known to occur in the Afrotropical Region, and the characters to distinguish them are primarily the shape of the male terminalia. These differences are often subtle and difficult to use without access to validly determined specimens for direct comparison.

KEY TO THE AFROTROPICAL SPECIES OF THE *GRISESCENS* GROUP (MALES ONLY)

1. Anterior surstylar process distinctly curved posteriorly in lateral view; posterior surstylar process with apical 1/3 conspicuously tapered, pointed apically; median margin of epandrium bearing several stout setae *P. cogani* Mathis
- Anterior surstylar process straight; posterior surstylar process broadly produced apically, if apical 1/3 tapered, gradual; median margin of epandrium with at most small setulae, no large setae 2
2. Posterior surstylar process with apex distinctly curved mediad (best seen in posterior view); in lateral view this process is slightly angulate sub-basally *P. grise-cens* Hendel
- Posterior surstylar process with general orientation of apex a continuation of basal portion, not distinctly curved medially, in lateral view this process tapered to pointed apex *P. pauliani* Mathis and Wirth

Procanace cogani Mathis

Figs. 27, 28

Procanace cogani Mathis, 1988b: 24 [figs. of ♂ terminalia].

Distribution.—Seychelles. Mahé: Anse Aux Pins (beach).

Type material.—Holotype ♂, USNM.

Procanace grise-cens Hendel

Figs. 29, 30

Procanace grise-cens Hendel, 1913: 93.—Wirth, 1951: 258 [revision, figs. of ♂ terminalia].—Miyagi, 1965: 96 [revision, figs. of ♂ and ♀ terminalia]; 1973: 82 [list].—Delfinado, 1970: 528 [list, New Guinea, figs. of ♂ and ♀ terminalia].—Canzoneri and Raffone, 1987: 75; Kenya. Ukunda.

Procanace fluvialis Canzoneri, 1987: 95 [habitus fig.]. NEW SYNONYM.

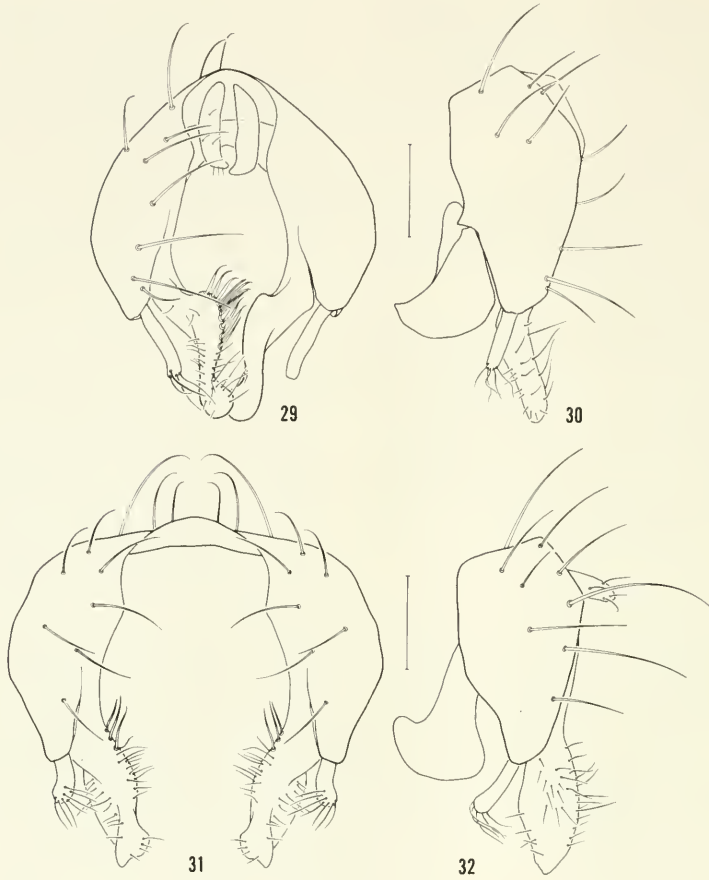
Distribution.—Widespread in the Old World tropics. Afrotropical: Kenya, Liberia (Suakoko), Nigeria (Ile-Ife, Zaria), Sierra Leone (Bathurst), Sudan (Khartoum, Nile River), Zaire (Yangambi). Australasian/Oceanian: Papua New Guinea, Yap Islands. Oriental: Bangladesh, Japan (Ryukyu Islands), Malaysia, Nepal, Taiwan (Anping, Tainan), Thailand.

Type material.—Syntypes (many) ♂♀ are from Taiwan: Anping (September), and are deposited in NMW.

The holotype ♂ of *P. fluvialis* is from Sudan: Khartoum, Nile River, 2 December 1980, Rallo and is deposited in MCV.

Natural history.—This is one of the few species of Canacidae that occurs in freshwater habitats, perhaps exclusively (all recorded localities for this species have not been checked).

Remarks.—We directly compared specimens of *P. grise-cens* that were collected on the Sauter expedition to Taiwan with the holotype and other specimens of *P. fluvialis* and could not find differences to distinguish them. We thus feel that the specimens stud-



Figs. 29, 30. Male terminalia of *Procanace grisescens*. 29, Epandrium, cerci, and surstyli, posterior view; 30, Epandrium, cercus, and anterior and posterior surstyliar processes, lateral view. Figs. 31, 32. Male terminalia of *Procanace pauliani*. 31, Epandrium, cerci, and surstyli, posterior view; 32, Epandrium, cercus, and anterior and posterior surstyliar processes, lateral view. Scale bar equals 0.1 mm.

ied are conspecific, hence our synonymy of the two names.

Procanace pauliani
Mathis and Wirth
Figs. 31, 32

Procanace pauliani Mathis and Wirth, 1979:
794.

Distribution.—Madagascar. Sud-Ouest:
dct Tuléar, Saint-Augustin (6 m).

Type material.—Holotype ♂, MNHN.

ACKNOWLEDGMENTS

Special thanks are extended to Fini Kap-
lan who made special effort to collect beach

flies from Cameroon, Kenya, and Nigeria and graciously made the specimens available to our study. We are grateful to Silvano Canzoneri (MCV) who kindly exchanged or loaned specimens, especially of species that he has described from the Afrotropical Region. We also thank Jon K. Gelhaus and Allen Norrbom for critically reviewing an earlier draft of this manuscript and suggesting improvements. The illustrations were skillfully inked by Ms. Elaine R. S. Hodges. Many specimens were collected as part of field work on the Seychelles and Aldabra, and we gratefully acknowledge funding from the Smithsonian Institution and

the guidance of Brian Kensley, who led our expedition there. We are also grateful for the cooperation of the Seychelles Islands Foundation for facilitating our field work.

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